THE PROBABILITY AND SEVERITY OF DECOMPRESSION SICKNESS (DCS)

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BACKGROUND

- Serious DCS is of greater concern than mild DCS
- For any dive, the Navy desires probabilities of <0.02 (2%) for mild DCS & <0.001 (0.1%) for serious DCS
- Distinction by severity makes DCS probability trinomial rather than binomial
- Hypothesis: mild and serious DCS have quantitatively different probabilities

METHODS

- We adapted Thalmann's "linear-exponential" (LE) DCS model for trinomial probability using an object-oriented computer language
- We applied various computationally advantageous methods
- Our system was able to reproduce earlier published results
- Models were fitted to 2,746 dive profiles consisting of a total of 8,578 dives (Temple *et al.* data, 1999)
- Differences in DCS probability were compared for no-stop air dives

METHODS

DCS Probability Models

Binomial Model

$P(\text{no DCS}) = e^{-\int r dt}$

$P(\text{all DCS}) = 1 - e^{-\int r dt}$

r = “instantaneous risk”

Trinomial Model #1

$P(\text{no DCS}) = e^{-a\int r dt}$

$P(\text{mild DCS}) = e^{-\int r dt} - e^{-a\int r dt}$

$P(\text{serious DCS}) = 1 - e^{-\int r dt}$

a = 8.7 (fitted parameter)

Trinomial Model #2

$P(\text{no DCS}) = be^{-\int r dt}$

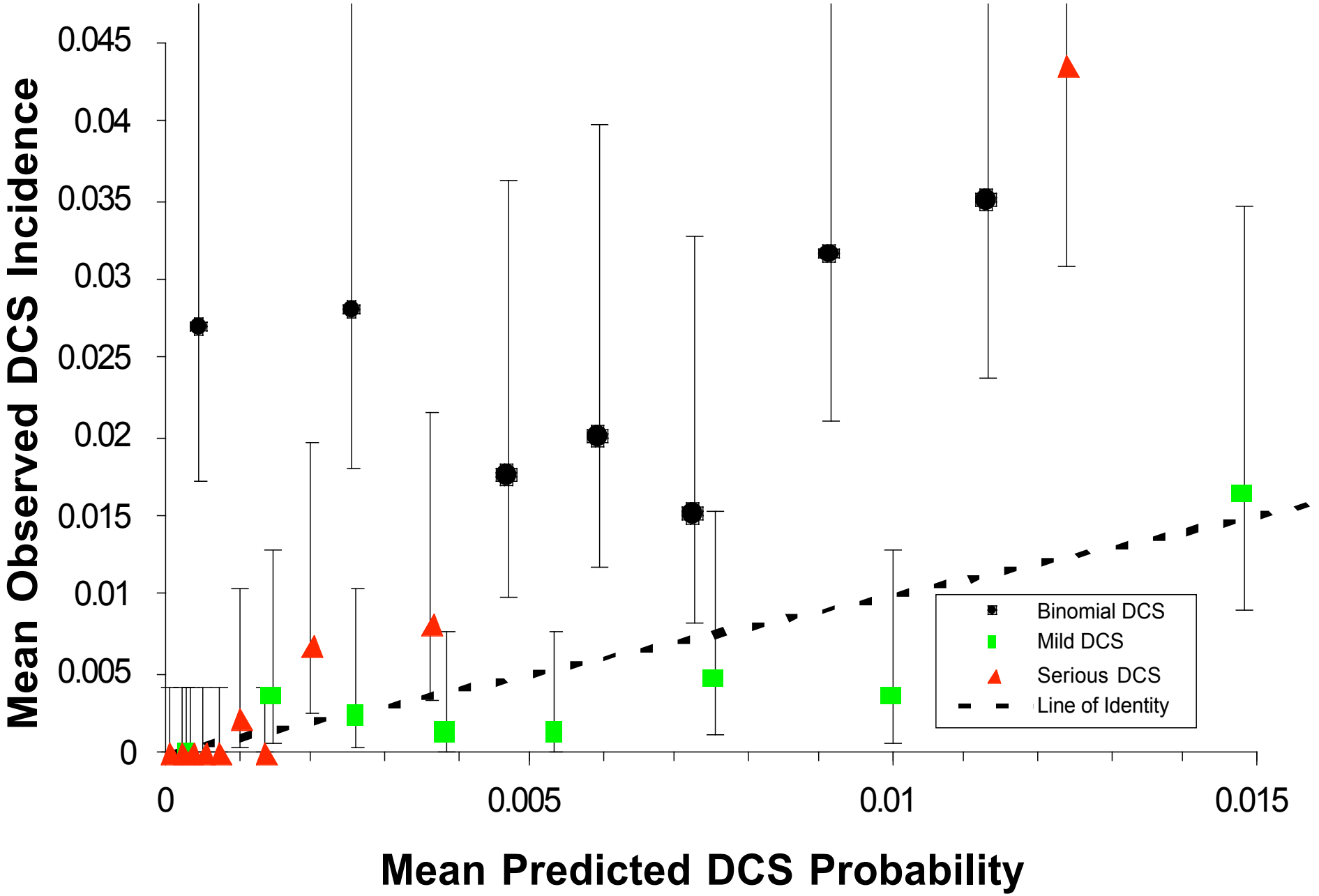
$P(\text{mild DCS}) = (1 - b)e^{-\int r dt}$

$P(\text{serious DCS}) = 1 - e^{-\int r dt}$

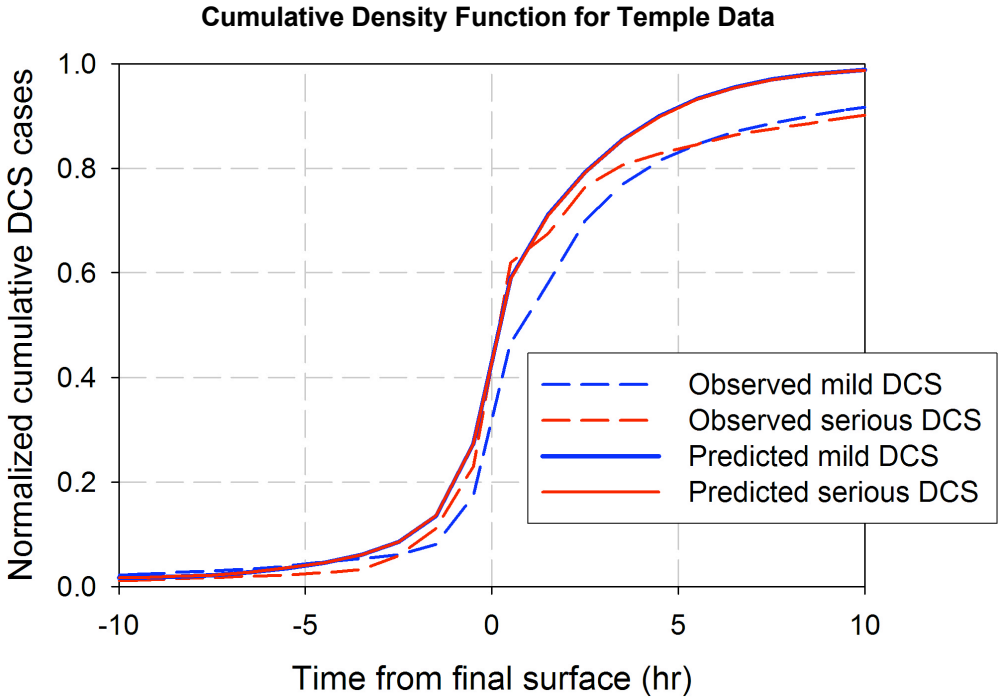
b = 0.87 (fitted parameter)

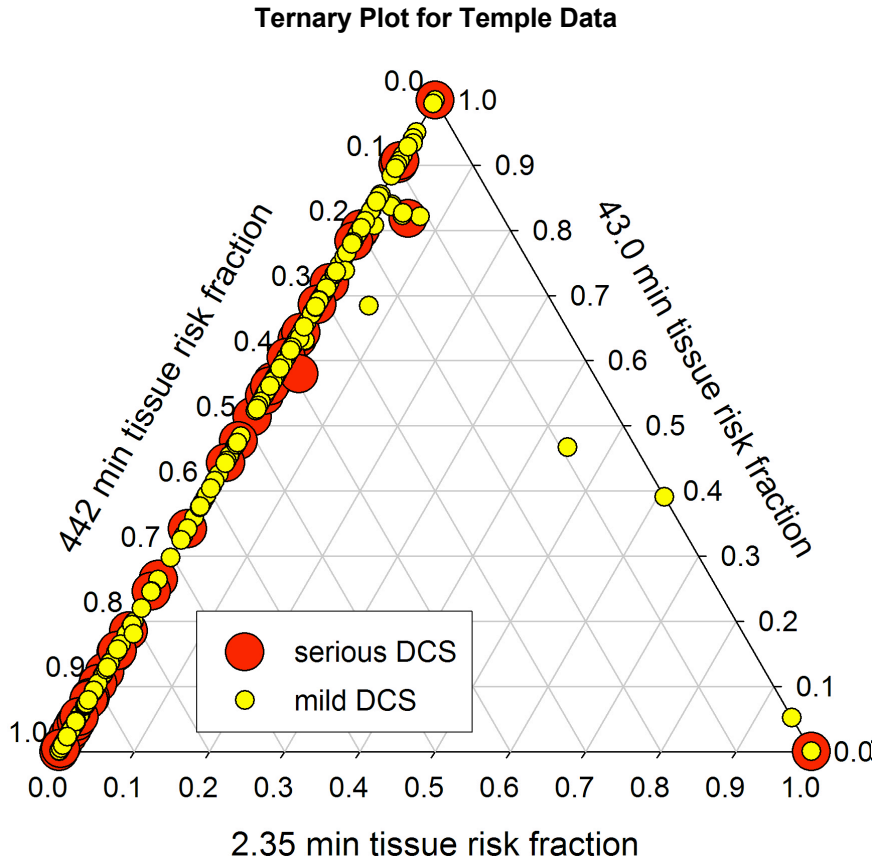
RESULTS

	Observed DCS Cases	Predicted DCS Cases
Binomial	434	436.4 ± 37.4
Trinomial		
- Mild (Subjective Neurological, Pain, Skin, and Constitutional Symptoms)	382	382.7 ± 36.6
- Serious (Objective Neurological, Motor and Cardiopulmonary Symptoms)	52	51.7 ± 14.0

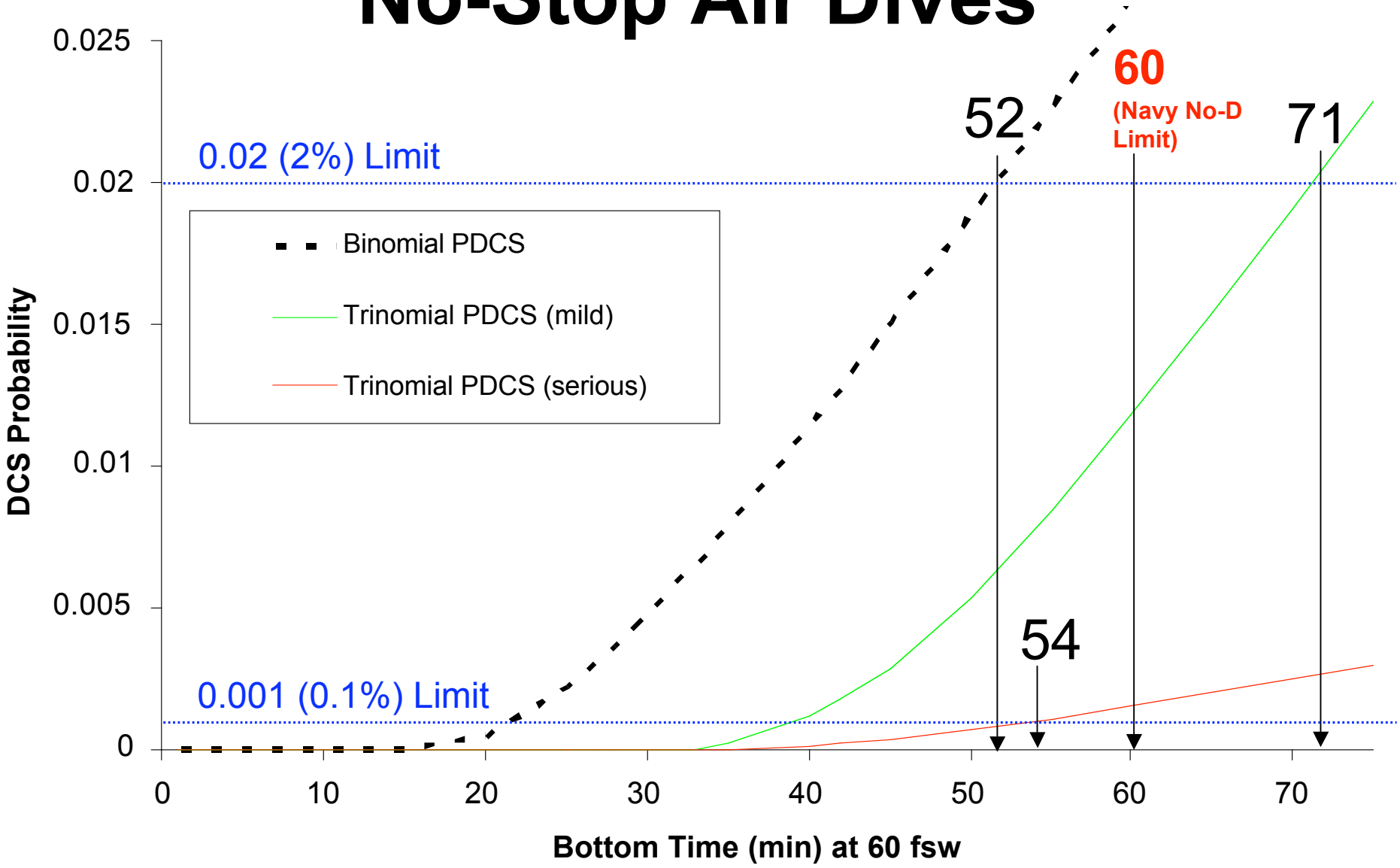

Observed vs. Predicted Binomial, Mild & Serious DCS
Mean Observed DCS Incidence
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
0
0.005
0.01
0.015
Mean Predicted DCS Probability
Binomial DCS
Mild DCS
Serious DCS
Line of Identity

Cumulative Density Function and Ternary Plot (Temple Data)

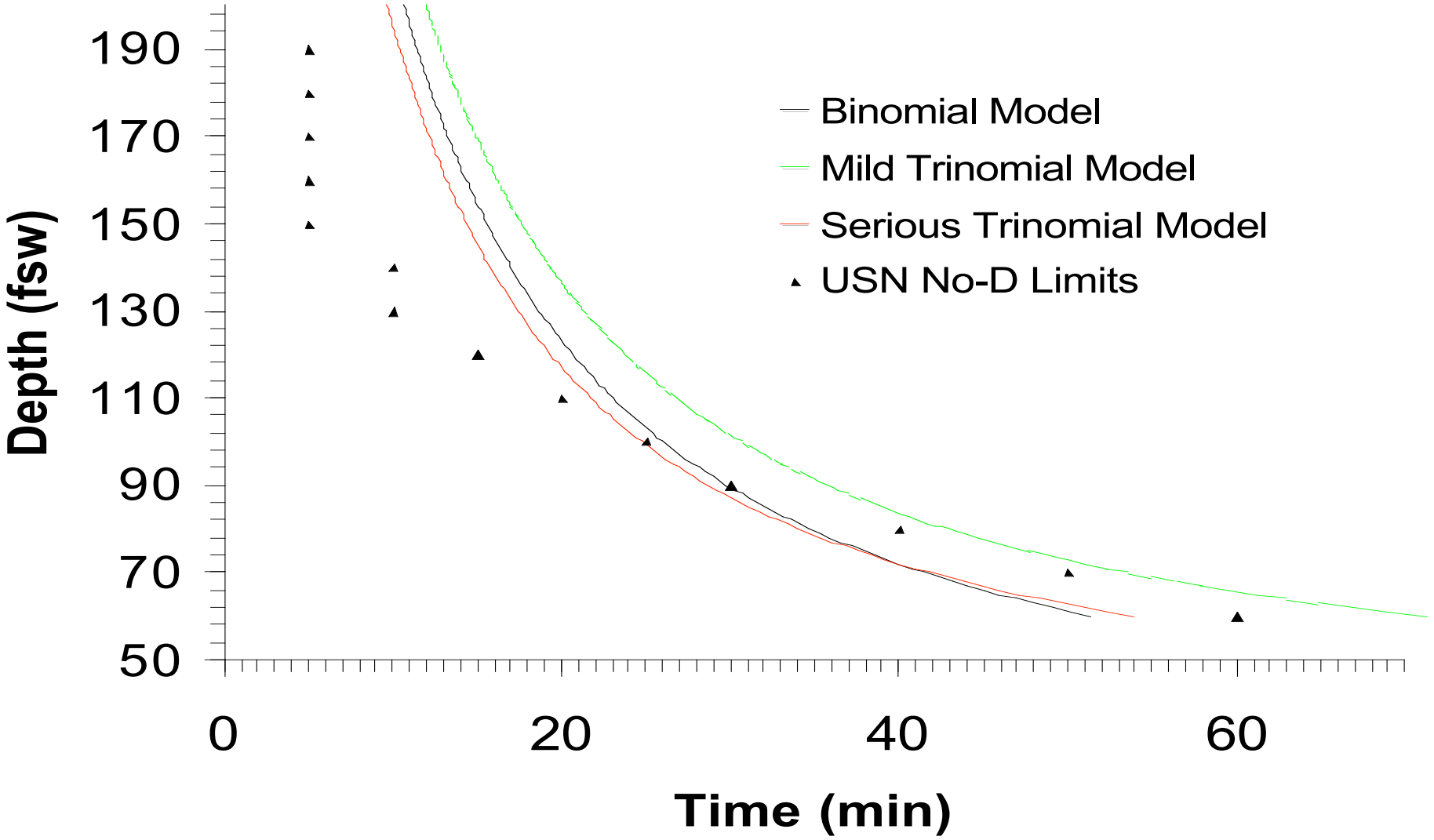




DCS Probabilities for 60 fsw No-Stop Air Dives



No-Stop Limits for Air Diving



CONCLUSION

- Mild and serious DCS have quantitatively different probabilities
- Predicted decompression procedures may differ according to DCS severity
- Predictions of the LE model depend strongly on the calibration data